UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Wisconsin Energy Corporation	**)**	
	)	**Docket No. EC14-126-000**
Integrys Energy Group, Inc.	**)**	

AFFIDAVIT OF WILLIAM HIERONYMUS AND DAVID HUNGER

1. We are William H. Hieronymus and David Hunger. We submitted testimony(Exhibit J-1) analyzing the effect of the proposed merger of Wisconsin Energy Corporation ("Wisconsin Energy" or "WEC") and Integrys Energy Group, Inc. ("Integrys") (collectively, "Applicants") that was submitted with their application pursuant to Section 203 of the Federal Power Act in Docket No. EC14-126-000. Our qualifications are contained therein. The purpose of this affidavit is to provide certain data and analysis in support of the Applicants' response to the letter the Commission sent to Applicants on November 19, 2014 that requested answers to four questions. This affidavit addresses the first three questions in the Commission's letter.

2. In our testimony, we concluded that the Wisconsin Upper Michigan System (WUMS) should not be considered a separate submarket within the Midcontinent Independent System Operator (MISO) market. In support of that conclusion we discussed the lack of prevalence of binding transmission constraints into WUMS. We also presented analysis in Table 7 showing that the prices in WUMS did not separate from MISO and in fact were lower in 8 of the 10 season load conditions considered in the delivered price test. In addition, our analysis of real-time prices between WUMS and MISO as a whole showed a correlation coefficient of 0.963, indicating a very strong price correlation, as would be expected for a single market.[1]

[1] In that initial analysis we inadvertently omitted Alliant-East (ALTE) price data from the calculation. Accordingly, we prepared a Corrected Table 7, which included ALTE in the calculation. This corrected Table was filed as an errata on September 18, 2014. Because the ALTE prices are very close to the average WUMS prices, including

QUESTION 1: PROVIDE DATA FOR THE THREE MOST RECENT YEARS FOR WHICH DATA IS AVAILABLE ON THE NUMBER OF HOURS WHERE THERE WERE BINDING CONSTRAINTS FOR THE WUMS AREA IN THE DAY-AHEAD MARKET AND THE REAL-TIME MARKET.

3. As a threshold matter, we note that we cannot supply the data relied upon by the MISO IMM or, more accurately, supply data that would allow the replication of the MISO IMM analysis that led to its conclusion that WUMS was constrained for more than 500 hours in each year.[2] The MISO IMM has listed about 300 flowgates in the WUMS NCA that define the WUMS system that are subject to mitigation.[3] However, the MISO IMM does not identify which of the interfaces in or into WUMS it found to have been constrained. Moreover, it is not even clear what constitutes a constraint as that term is used by the MISO IMM. As shown in Table 1 below, data summarized in some the MISO IMM's annual reports indicate that a large share of the "constraint" hours used in the NCA designation are not hours in which there was an actual constraint.

4. Table 1 shows the data presented in the NCA Update Filings for the years 2008-13. From this table, it appears quite likely that, in recent years, WUMS would not have been classified as an NCA had the 500 hour threshold been based exclusively on hours when constraints actually were binding. For example, in 2010 only 353 of the 661 congestion hours identified by the MISO IMM in WUMS consisted of hours in which the identified interface actually was constrained. In 2011, the number of actual constraint hours was 478. The MISO IMM did not provide data on actual constraint hours in its last two NCA Update Filings, so we do not know how many of the total

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them in the calculation did not change the basic conclusion reached from Table 7, which is that prices in WUMS are very much in line with the prices in MISO as a whole, and in fact generally are slightly lower than prices in MISO as a whole, and that WUMS therefore should not be treated as separate market. Including ALTE in the calculation also increased the correlation coefficient between WUMS and the rest of MISO from 0.960 to 0.963.

[2] Although Staff requested data on both real-time and day-ahead constraints, the MISO IMM only provides data on real-time congestion in its NCA Update filings.

[3] The list of flowgates identified by MISO appears at https://www.misoenergy.org/Library/Repository/Report/IMM/2013%20WUMS%20NCA%20Constraints.PDF. For the Commission's convenience, a copy of this list is attached as Exhibit D.

congestion hours identified by the MISO IMM in 2012 and 2013 were hours when there actually was a constraint.

Table 1 — MISO IMM NCA Determination of Hours of Congestion for WUMS[4]

Year	Hours Used in NCA Designation	Actual Constraint Hours
2008	2,495	774
2009	1,104	Not Listed
2010	661	353
2011	662	478
2012	513	Not Listed
2013	765	Not Listed

5. Lacking information from the MISO IMM on the congestion used in designating WUMS as an NCA, we are supplying the raw data on constraints from the MISO web site. These data are contained in our workpapers. Because the data are voluminous and cover hundreds of potentially constrained interfaces, we are providing herein our analysis of these data and the conclusion we have drawn from them concerning whether WUMS should be regarded as a market separate from the rest of MISO. We first discuss the real-time market.

Data on Real-Time Constraints

6. In order to identify transmission facilities that potentially could cause WUMS to separate from the rest of MISO, we analyzed constraints on all flowgates in WUMS and neighboring areas for the years 2011-2013, the three most recent years for which there is a full year of data available, and which correspond to the most recent data in

[4] Sources: Potomac Economics, "Informational Filing of Midwest Independent Transmission System Operator, Inc.'s Independent Market Monitor," Docket No. ER07-235-000, Mar. 31, 2009, Feb. 25, 2010, Jan. 18, 2011, Feb. 3, 2012, Feb. 21, 2013, March 7, 2014).

the MISO IMM NCA Update Filings.[5] To summarize, we performed a three-part analysis of these data. First we evaluated all flowgates in MISO and surrounding areas (not just the approximately 300 flowgates that the MISO IMM uses to define WUMS) to determine which ones experienced congestion in a way that potentially could have caused WUMS to have separated into a submarket within MISO. Second, we determined the number of hours over the last three years when these facilities were congested. Third, we analyzed the specific hours when the facilities we identified were congested in order to determine whether that congestion could have caused WUMS to separate from the rest of MISO.

7. In the first step, we applied a conservative two-part screen to analyze all flowgates in MISO and surrounding areas. Any facility that satisfied both of these criteria then was included in the second and third parts of the analysis. The two parts of the screen are as follows:

    a. First, we identified all facilities that were constrained for 87 or more hours (*i.e.*, 1% of all hours of the year) for either 2011, 2012 or 2013.

    b. Second, we identified all facilities with transfer distribution factors ("TDF") of 2% or more for sources of marginal energy supplies, *i.e.* the generation capacity setting the LMP, located in MISO and sinking at load in WUMS. In other words, this screen identified all transmission facilities that flowed 2% or more of the marginal generation that set the LMPs in WUMS.

8. Any facility that does not meet each of these criteria is unlikely to cause WUMS to separate non-trivially from MISO: a facility that is constrained less than 1% of the hours of the year will not materially affect transmission into WUMS, and a facility that has a TDF of less than 2% for marginal LMP-setting supplies in WUMS is unlikely to affect prices appreciably in WUMS even when it is constrained.

9. Even with these very low thresholds, there were only two facilities that were constrained 87 or more hours in 2011, 2012 or 2013 and had a TDF of 2% or more. The first facility, which met the screening criteria only in 2011, runs from Cypress to

[5] The Applicants are submitting a separate file with the data used to perform this analysis.

Forrest Junction in the middle of WUMS. Given its location, this facility cannot be considered an interconnection facility that, when constrained, would prevent imports into WUMS. The second facility, the MWEX interface, is a major 345 kV interface connecting WUMS with Minnesota to the west and clearly is an interconnection facility into WUMS.[6]

10. The fact that only one transmission facility out of all the facilities analyzed is an interconnection facility that satisfies both elements of this very conservative screen in and of itself constitutes important evidence that WUMS is not a separate geographic market. Unless the MWEX line by itself could cause WUMS to separate (and as explained in response to Question 2 below, constraints on this line do not cause WUMS to separate), then this evidence alone indicates that transmission congestion is not causing WUMS to separate even before considering the amount and timing of congestion on the MWEX line, described below.

11. We recognize, however, that there were four other 345 kV lines that connect WUMS to the south: (1) Wempletown-Rockdale, (2) Wempletown-Paddock, (3) Zion-Arcadian, and (4) Zion-Pleasant Prairie.[7] Flowgates involving these lines were included in the screening analysis described above and did not meet the 87 constraint hours/2% TDF criteria. Nevertheless, because these four lines are high voltage lines interconnecting WUMS to the rest of MISO, we included them in the second and third part of our analysis as described below.

12. The second part of the analysis is to determine the number of real-time congestion hours experienced on the MWEX line and the four other interconnection lines identified above for the years 2011-13. Table 2 below provides this information.

[6] The interface consists of the Arrowhead to Stone Lake and the King to Eau Claire 345 kV transmission lines.

[7] A sixth 345 kV line was placed into service between the Zion Energy Center and Pleasant Prairie on December 6, 2013. However, because that line was in service for only a small part of 2013, it is not included in the Applicants' analysis.

Table 2 — Real-time Constraint Hours Into WUMS and Estimated Price Impacts

Transmission Facility	Real-Time Constraint Hours 2011	2012	2013	Average Hourly Price Impact[8] ($/MWH)
MWEX	4.6	10.1	113.8	0.06
Zion-Pleasant Prairie	0.1	0.0	0.8	0.00
Zion-Arcadian	0.0	0.0	0.0	0.00
Wempletown-Paddock	0.0	0.0	0.0	0.00
Wempletown-Rockdale	0.0	0.0	0.0	0.00

13. There are several conclusions that can be reached from Table 2:

a. First of all, the table confirms the results of the screening analysis described above that there are no concerns that congestion on the four southern 345 kV interconnections into WUMS are causing WUMS to separate. There were no real-time constraint hours into WUMS at all on three of these lines during the 2011-13 period, and less than an hour of constraints into WUMS on the fourth over the same three years.[9]

b. Second, the number of constraint hours on the MWEX line is not material. At most, the 113.8 constraint hours in 2013 represents 1.3% of the hours in that year. The number of constraint hours in 2011 and 2012 was an order of magnitude lower.

8 The average hourly price impact is the average amount by which the constraint affected prices in WUMS over the three year period. It is calculated as equal to the shadow price for each generation facility that flows over the constraint for each hour of the constraint, times each such generation facility's TDF for that constraint, divided by the number of hours in the three year period.

9 The Pleasant Prairie to Zion and Arcadian to Zion lines were at times constrained for transmission of electricity out of WUMS for deliveries to the south. However, the Commission has previously found that transmission congestion on lines exiting an area, as opposed to transmission congestion into the area, does not support a finding that the area should be analyzed as a separate geographic submarket. *See AEP Power Marketing, Inc*., 124 FERC ¶ 61,274 at P 24 (2008) (rejecting the establishment of western PJM as a separate geographic submarket because "[a]ny binding transmission constraints in PJM are west to east, rather than east to west.").

c. Third, the effect of the constraints on WUMS prices was miniscule. Even the effect of the MWEX constraint on hourly prices in WUMS—six cents/MWh (approximately 0.2 percent of the average WUMS real-time price for the period - $28.87/MWh)—was negligible.[10]

14. We recognize that Table 2 shows considerably fewer constraint hours than were included by the MISO IMM in its NCA Update Filings. Because the MISO IMM has not identified which facilities it analyzes or how it does its analysis, we are unable to explain why the MISO IMM has identified a substantially larger number of congestion hours. The most likely explanation is that the MISO IMM includes in its calculation congestion internal to WUMS. The MISO IMM may also have counted constraints on lower voltage lines that, by their nature, are less capable of causing significant price separation between WUMS and the rest of MISO. In any event, our finding that the major transmission lines connecting WUMS and the rest of MISO rarely are congested means that WUMS as a whole is almost never likely to be a load pocket within MISO and hence is not a submarket within MISO for purposes of conducting a merger-related competition analysis.

15. We also analyzed data on constraints to determine when the real-time congestion hours occurred. Attached as Exhibit A is a series of charts, showing for each of the two flowgates identified above that experienced any congestion, the month, day, and hour that congestion occurred for the 2011-13 period. Given the minimal amount of congestion that occurred on the Zion-Pleasant Prairie flowgate and the minimal amount of congestion that occurred on the MWEX flowgate in 2011 and 2012, it is not surprising that the charts show that, in total, there were only four hours of congestion in the summer period in 2011 and 2012, and only two of those were in the afternoon when the peak prices occur. Nor did the congestion hours in those years occur in any kind of discernible, predictable pattern that would have allowed generators to forecast the congestion in bidding into the MISO market in order to take advantage of the congestion.

16. There were 113.8 constraint hours on the MWEX line in 2013, but Exhibit A again shows that the constraints tended not to occur "during historical seasonal peaks

[10] Load weighted real-time average price, see Workpapers_WUMS_Electricity_Prices for data and calculation.

examined in the screens and at other competitively significant times." Order No. 697 at P 268. Indeed, none of the constraint hours for MWEX in 2013 occurred in the summer months when seasonal peaks typically occur. Instead, the constraints occurred primarily in the shoulder months, and they tended to be distributed throughout the day rather during the afternoon peak hours.

17. Furthermore, there were no sustained periods of constraints that would allow generators to predict the occurrence of a constraint and act to withhold capacity on an economic or physical basis to attempt to raise prices. Indeed, there were only two months—April and October of 2013—when there were constraint hours on consecutive days.

18. Finally, we analyzed the data to determine the extent to which there was congestion on both MWEX from the west and one of the transmission lines from the south into WUMS. There were no real-time periods in which constraints occurred simultaneously on MWEX and a 345 kV line from the south. Therefore, the constraints were not jointly causing WUMS to separate into a submarket. This finding is highly relevant to our answer to Question 2.

Data on Day-Ahead Constraints

19. Day-ahead congestion is not as important as real-time congestion because day-ahead transactions are financially settled, not physical. Practically, the real-time market is the last-in-time market and virtual bids and offers allowed in the day-ahead market should cause day-ahead prices to approximate real-time prices on average. Because of hedging activity and the ability of MISO to resolve day-ahead constraints via unit commitment decisions, there will tend to be more day-head than real-time constraint hours on a facility. But the pricing effects should be less (per hour) for day-ahead constraints so that the overall price effects will be comparable to average price effects in real-time transactions.

20. These expectations are consistent with findings by the MISO IMM. In its 2013 State of the Market Report, the MISO IMM notes that "[p]articipants' day-ahead market bids and offers should reflect their expectations of market conditions for the

following day".[11] The State of the Market Report then presents an analysis showing that, in fact, day-ahead and real-time prices do converge in MISO, with a small premium afforded to day-ahead prices due to lower price volatility.[12] In any event, the MISO IMM's NCA analysis considers only real-time congestion so the finding that WUMS is an NCA that is the basis for an inquiry into whether WUMS is a separate market inherently relates to the real-time market.

21. The MISO web site has data on day-ahead congestion similar to the real-time data that it posts. Table 3 shows the same data regarding number of constraint hours for the 5 interconnection facilities that were analyzed above.

Table 3 — Day-Ahead Constraint Hours into WUMS and Estimated Price Impacts

	Day-Ahead Constraint Hours			Average Hourly Price Impact
Transmission Facility	2011	2012	2013	($/MWH)
MWEX	457	877	713	0.11
Zion-Pleasant Prairie	981	32	2	0.13
Zion-Arcadian	0	95	187	0.01
Wempletown-Paddock	0	0	0	0.00
Wempletown-Rockdale	0	0	0	0.00

22. As expected, there are more day-ahead congestion hours on these interconnection facilities than real-time congestion hours for the 2011-13 period. However, there was no day-ahead congestion on two of the lines, and except for the Zion-Pleasant Prairie flowgate in 2011, the day-ahead congestion hours have been 10% or less of all hours for the year. The price effects again are minimal, ranging from 1 cent to 13

11 2013 State of the Market Report at 23.

12 *Id.* at 24.

cents/MWh (at most, approximately 0.4 percent of the average WUMS day-ahead price for the period - $29.71/MWhs)—.[13]

23. Further, we conducted a similar hour-by-hour analysis of the three flowgates that experienced some amount of congestion; the results of this analysis are shown on the charts in attached Exhibit B. These charts show that the day-ahead congestion is not concentrated in the peak summer hours. Indeed, the day-ahead congestion for the Zion-Pleasant Prairie line in 2011, which had the greatest amount of congestion in the analysis, occurred almost entirely in January and February of that year. Except for those two months for that line, the pattern of day-ahead congestion was sporadic and unpredictable.

24. As with real-time hours, we also examined whether MWEX was simultaneously binding with one of the transmission lines from Zion into WUMS, in order to evaluate whether simultaneous constraints in more than one line could cause WUMS to separate in the day-ahead market. We found that the facilities were simultaneously binding for 35 hours in 2011, 18 hours in 2012, and 17 hours in 2013. Accordingly, transmission constraints both west and south of WUMS caused WUMS to be separate from the rest of MISO in no more than 0.4 percent of the hours in any year. Further, charts showing the hourly occurrence of the simultaneous day-ahead constraints, attached as Exhibit C, show that the simultaneous constraints were not concentrated at peak periods and occurred sporadically and unpredictably.

QUESTION 2: APPLICANTS NOTE THAT THERE ARE NUMEROUS INTERCONNECTIONS INTO WUMS FROM SEVERAL DIFFERENT LOCATIONS AND ASSERT THAT CONGESTION ON ONE INTERCONNECTION DOES NOT CAUSE WUMS, AS A WHOLE, TO HAVE PRICE SEPARATION FROM THE REST OF MISO. PLEASE PROVIDE THE DATA THAT APPLICANTS RELIED UPON TO MAKE THIS ASSERTION.

25. The conclusion that congestion on one interconnection does not cause price separation in WUMS is supported by the price comparison that we submitted as Table 7 to our testimony (Exhibit J) and the supporting workpapers. The comparison shows

[13] Load weighted day-ahead average price, see Workpapers_WUMS_Electricity_Prices for data and calculation.

that prices in WUMS have not separated from the rest of MISO, which indicates that congestion on the interconnections between WUMS and the rest of MISO has not caused WUMS to separate into a separate market.

26. As described in our answer to Question 1, we now provide an analysis of the constraint hours and generation shift factors for the interfaces that potentially could cause WUMS to separate from the rest of MISO. As described in that answer, only one facility, the MWEX interface, met the test for a potentially significant impact. In answering Question 1, we provided data on the frequency, price impact and time pattern of constrains on the major interfaces into WUMS that further confirm that WUMS does not separate from the rest of MISO to any significant degree.

27. In this answer, we provide an additional analysis that supports our contention that WUMS is not a separate market. In this analysis, we calculated how much generation (within WUMS and in other parts of MISO that were not potentially impacted by a constraint on the 345 kV interfaces) would be in the same market. In brief, the analysis shows how much generation is on the "WUMS side" of each interconnection facility. In other words, it shows how much generation still would be able to be delivered into WUMS when that particular transmission facility is constrained.

28. This analysis then can be used to determine whether any of the constraints by themselves could cause WUMS to separate. If a constraint on a single line were to cause WUMS to separate into a separate market, then the analysis would show that only the 18,596 MW of capacity located in WUMS[14] would be on the "WUMS side" of the constraints. However, as the following Table 4 shows, there is considerably more than that amount of capacity on the "WUMS side" of each interconnection.

[14] See Workpaper J-6.3.1 Units in MISO, filed August 18, 2014.

Table 4 — Quantity of Generation on "WUMS Side" of Interconnection Facilities

Transmission Facility	Generation Capability on the WUMS Side of Facility (MW)	Generation Capacity in WUMS (MW)	Generation on the WUMS Side Outside of WUMS (MW)
MWEX	89,304	18,596	70,708
Wempletown-Rockdale	43,589	18,596	24,993
Wempletown-Paddock	42,587	18,596	23,991
Zion-Arcadian	54,151	18,596	35,555
Zion-Pleasant Prairie	53,184	18,596	34,588

29. As Table 4 shows, there is from 129% to 380% more generation outside of WUMS than inside WUMS on the "WUMS side" of each interconnection. For the MWEX line, this additional generation capacity is located in Iowa and in areas south and east of Wisconsin and Iowa. For the transmission lines from Wempletown, areas west and north of Wisconsin and Iowa are included in the same region as WUMS. For the lines running north from Zion, Iowa is also included in the same side of the constraint as WUMS.

30. Consequently, the specific data regarding the 345 kV transmission lines leading into WUMS point to the same conclusion as the price data that we submitted in our initial testimony. Constraints on one of the interconnections into WUMS do not cause WUMS to separate into a separate market from large portions of MISO.

31. It is theoretically possible that, if there were simultaneous constraints on more than one of the interconnections, that might create a smaller submarket equivalent to WUMS. However, as explained in response to Question No. 1, the MISO data show that there never were any simultaneous constraints of these interconnections in real time in the 2011-13 period, and that there were simultaneous day-ahead constraints in only 0.4% of the hours in this same period.

32. It is true that constraints on these facilities will cause temporary price differences within the MISO market—this is an inevitable consequence of a constraint on any facility in any market. As discussed in our initial testimony, such differences on occasion may separate part of WUMS from the rest of WUMS, but do not cause all of WUMS to separate from the rest of MISO. The fact that there is a significant amount of generation located outside of WUMS that is on the "WUMS side" of each

significant interconnection into WUMS means that constraints on these interconnections do not create a separate portion of MISO that is limited to WUMS.

QUESTION 3: PLEASE PROVIDE SUPPORT FOR WHY FACTORS OTHER THAN CONGESTION, SUCH AS THE MOVEMENT OF GAS PRICE OR TEMPERATURE, DO NOT EXPLAIN THE CORRELATION BETWEEN PRICES ON EITHER SIDE OF THE WUMS MARKET.

33. Our conclusion that WUMS should not be considered a submarket within MISO was supported: (1) by the fact that the congestion into and within WUMS did not lead to price separation between WUMS and the rest of MISO; and (2) by the high correlation coefficient (0.963) between WUMS and MISO as a whole. We interpret Staff's request as raising the point that prices both within and outside WUMS could be being driven by the same underlying fundamentals – gas prices on the supply side and temperature on the demand side, even if they weren't part of the same market. From there, a reasonable question to ask is whether even if two regions were electrically isolated from each other; could they have the same (or very similar) price movements (and thus high correlation coefficients) even though they are separate markets?

34. In order to address the question we have taken Staff's proposed factors (natural gas prices and temperature) in the relevant geographic regions (WUMS and the rest of MISO) and computed the full correlation coefficient matrix for all of these variables. To be sure, electricity prices are correlated to some degree to natural gas prices and temperatures. Consequently, some of the correlation between WUMS prices and MISO prices that we first observed is due to those factors. However, as explained in detail below, the correlation between the prices in WUMS and rest of WUMS is much stronger than the correlation between temperatures and prices or between gas prices and electricity prices, indicating that WUMS and the rest of MISO are part of the same relevant market, rather than two separate markets with prices being driven by temperature and natural gas prices.

35. Table 5 shows the full correlation coefficient matrix between WUMS prices (MISO Zone 2), MISO pricing zone prices, temperature, and natural gas prices in the relevant

regions.[15] Each cell shows the correlation coefficient between the variables in the row and column of the cell. For example, for the WUMS column, the electricity price is perfectly correlated with itself; has a 0.89 correlation coefficient with the Indiana Hub electricity price; has a 0.34 correlation coefficient with Alliance natural gas price; and has a 0.11 correlation coefficient with the Madison, Wisconsin temperature.

Table 5 - Full Correlation Coefficient Matrix

All Data Pearson Correlation Matrix (2012-2013) — *731 observations*

		Electricity Prices				Gas Prices			Temperature		
		WUMS	Indiana Hub	Illinois Hub	Michigan Hub	ANR-ML7	Alliance	Chicago	Madison, WI	Minneapolis, MN	Chicago, IL
Electricity Prices	WUMS	1.00									
	Indiana Hub	0.89	1.00								
	Illinois Hub	0.85	0.82	1.00							
	Michigan Hub	0.86	0.92	0.81	1.00						
Gas Prices	ANR-ML7	0.30	0.27	0.23	0.20	1.00					
	Alliance	0.34	0.31	0.26	0.24	0.95	1.00				
	Chicago	0.30	0.27	0.23	0.20	1.00	0.96	1.00			
Temperature	Madison, WI	0.11	0.09	0.15	0.17	-0.19	-0.23	-0.20	1.00		
	Minneapolis, MN	0.09	0.07	0.14	0.14	-0.20	-0.24	-0.21	0.97	1.00	
	Chicago, IL	0.11	0.09	0.15	0.17	-0.20	-0.24	-0.21	0.99	0.96	1.00

36. Next, because the temperature data has different meaning in the winter and in summer regarding electricity demand, we split the data into two seasons. Specifically, all else equal, in the summer the higher the average daily temperature the higher the demand for electricity, while in the winter temperature has the opposite effect. Tables 6 and 7 show the seasonal breakouts.

[15] The correlation coefficients shown in Tables 5-7 are statistically significant at extremely high levels across the tables, with all of the electricity price correlations significant at the 0.001 level (in other words greater than 99% confidence level).

Table 6 – Summer Correlation Coefficient Matrix

Summer Data Pearson Correlation Matrix (May-October, 2012-2013) — *368 observations*

		Electricity Prices				Gas Prices			Temperature		
		WUMS	Indiana Hub	Illinois Hub	Michigan Hub	ANR-ML7	Alliance	Chicago	Madison, WI	Minneapolis, MN	Chicago, IL
Electricity Prices	WUMS	1.00									
	Indiana Hub	0.90	1.00								
	Illinois Hub	0.89	0.87	1.00							
	Michigan Hub	0.88	0.93	0.84	1.00						
Gas Prices	ANR-ML7	0.08	0.13	0.12	0.07	1.00					
	Alliance	0.14	0.19	0.16	0.12	0.95	1.00				
	Chicago	0.08	0.13	0.12	0.07	1.00	0.95	1.00			
Temperature	Madison, WI	0.34	0.24	0.30	0.30	-0.24	-0.27	-0.26	1.00		
	Minneapolis, MN	0.28	0.16	0.24	0.21	-0.22	-0.27	-0.24	0.92	1.00	
	Chicago, IL	0.33	0.24	0.29	0.30	-0.26	-0.28	-0.28	0.98	0.88	1.00

37. By breaking out the data by cooling and heating seasons (which we call "summer" and "winter", recognizing that they are not the standard definition of those terms) we predictably see a stronger correlation between the temperature and electricity prices. For example, as shown in Table 6 (for the summer period), for the WUMS electricity price, the correlation coefficient with the temperature in Madison, Wisconsin increases from 0.11 over the entire year to 0.34 in the summer, owing to the more accurate connection to electricity demand due to removing the opposite effect of temperature in the winter.

Table 7 - Winter Correlation Coefficient Matrix

Winter Data Pearson Correlation Matrix (November-April, 2012-2013) — *363 observations*

		Electricity Prices				Gas Prices			Temperature		
		WUMS	Indiana Hub	Illinois Hub	Michigan Hub	ANR-ML7	Alliance	Chicago	Madison, WI	Minneapolis, MN	Chicago, IL
Electricity Prices	WUMS	1.00									
	Indiana Hub	0.87	1.00								
	Illinois Hub	0.78	0.73	1.00							
	Michigan Hub	0.81	0.89	0.72	1.00						
Gas Prices	ANR-ML7	0.60	0.51	0.41	0.44	1.00					
	Alliance	0.62	0.53	0.41	0.45	0.96	1.00				
	Chicago	0.60	0.51	0.40	0.44	1.00	0.96	1.00			
Temperature	Madison, WI	-0.29	-0.21	-0.12	-0.13	-0.32	-0.39	-0.32	1.00		
	Minneapolis, MN	-0.27	-0.19	-0.07	-0.12	-0.36	-0.42	-0.35	0.94	1.00	
	Chicago, IL	-0.29	-0.22	-0.13	-0.14	-0.31	-0.39	-0.31	0.98	0.90	1.00

38. Table 7 shows the correlation matrix for the same set of variables for the winter period and also provides predictable results. For example, the correlation coefficient between the

WUMS electricity price and the Madison Wisconsin temperature is -0.29, indicating that as the temperature goes down, electricity price increases. Again, as in the summer breakout and the year taken as a whole, the strong correlation between MISO Zone 2 (WUMS) prices and the neighboring pricing hubs in MISO remains by far the strongest factor.

39. The methodology for constructing the data set and calculating the correlation coefficients is described in detail in the workpapers.[16] There is one major difference between the correlation coefficient calculated in the original testimony and the ones presented here that was required due to the availability of data. Here, we use daily average prices rather than the hourly prices that we used in our original testimony. We did that because the gas price data are available only in daily rather than hourly levels. This explains the slightly lower correlation coefficient (from 0.96 to the range of 0.78 - 0.89) between prices inside and outside of WUMS because the largest hourly deviations from the mean are muted in the averaging calculation. Since the correlation coefficient between two variables will increase as both move together away from their respective mean values, all else equal, muting those large variations will decrease the correlation coefficient of two highly correlated variables. In economic terms, that means that during the extreme range of demand conditions seen in the hourly data, the prices move together (as one would expect in a single market) and some of that is lost in the daily averaging. Despite that, the correlation coefficients remain very high, again indicating a single market in MISO rather than a distinct WUMS submarket.

40. Another check that we performed was to compare the correlation coefficients of the other pricing points within MISO with their correlation to WUMS prices. If the other pricing points within MISO were highly correlated with each other but not with WUMS prices, that could indicate that WUMS is a separate submarket. That is emphatically not the case here. However we slice it, the correlation among the pricing points is extremely high. Zooming in on the correlation coefficients for the four pricing points below, it is clear that they are all part of the same market. WUMS has a correlation coefficient of 0.90, 0.89, and 0.88 with the Indiana, Illinois, and Michigan Hubs, respectively. Michigan is highly correlated with Indiana and Illinois (0.93 and 0.84); and Indiana is also highly correlated with Illinois (0.87). In addition, going back to Tables 5 – 7, the correlation between the various hubs is much higher than the correlation between the hubs and temperature of natural gas prices.

16 See, Data Request Response Workpapers – Methodology tab.

Table 8: Electricity Price Correlations Summer 2012-2013

		Electricity Prices			
		WUMS	Indiana Hub	Illinois Hub	Michigan Hub
Electricity Prices	WUMS	1.00			
	Indiana Hub	0.90	1.00		
	Illinois Hub	0.89	0.87	1.00	
	Michigan Hub	0.88	0.93	0.84	1.00

41. Another check that we performed was to compare correlation coefficients between temperature and electricity prices, gas prices and electricity prices, and electricity prices inside and outside of WUMS. If WUMS is a submarket and its prices are simply being driven by the same factors (gas prices and temperature) that drive the other prices within MISO, then there should be a much higher correlation coefficient between gas prices and electricity prices or between temperature and electricity prices than between electricity prices inside and outside of WUMS. Again, that is not the case. Reviewing the relevant portion of Table 6, as shown below as Table 9, we can see that while the correlation coefficient between gas prices and electricity prices ranges from 0.07 – 0.19, the correlation coefficient between WUMS and outside of WUMS electricity prices ranges from 0.84 – 0.93. Likewise, while the correlation coefficient between temperature and electricity prices ranges from 0.16 - 0.34 while the correlation coefficient between WUMS and outside of WUMS ranges from 0.84 – 0.93. So while temperatures in the region are highly correlated with each other and gas prices are highly correlated with each other; neither factor is highly correlated with electricity prices.

Table 9: Summer Electricity, Gas and Temperature Correlations:

		Electricity Prices			
		WUMS	Indiana Hub	Illinois Hub	Michigan Hub
Electricity Prices	WUMS	1.00			
	Indiana Hub	0.90	1.00		
	Illinois Hub	0.89	0.87	1.00	
	Michigan Hub	0.88	0.93	0.84	1.00
Gas Prices	ANR-ML7	0.08	0.13	0.12	0.07
	Alliance	0.14	0.19	0.16	0.12
	Chicago	0.08	0.13	0.12	0.07
Temperature	Madison, WI	0.34	0.24	0.30	0.30
	Minneapolis, MN	0.28	0.16	0.24	0.21
	Chicago, IL	0.33	0.24	0.29	0.30

42. In conclusion, the Commission posed a thoughtful question that required us to broaden our analysis in order to answer it. By looking at two critical demand and supply side factors (temperature and natural gas prices) in addition to prices inside and outside of WUMS we got a more complete picture of the market conditions. As expected, temperature and gas prices were correlated with electricity prices and in the right direction. For example, in the winter, the correlation between temperature and electricity price is negative. However, the correlation coefficient between electricity prices inside and outside of WUMS is consistently much higher (nearly 1.0) which would indicate a perfect linear relationship. These factors reinforce our conclusion that WUMS should not be newly classified as a submarket, but rather continue to be considered part of the broader MISO market.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Wisconsin Energy Corporation	**)**	
	)	**Docket No. EC14-126-000**
Integrys Energy Group, Inc.	**)**	

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I, David Hunger, Ph.D., being duly sworn, depose and state that the foregoing Affidavit on behalf of the Wisconsin Energy Corporation and Integrys Energy Group, Inc.is true, correct, accurate, and complete to the best of my knowledge, information, and belief.

_____
David Hunger, Ph.D.

SUBSCRIBED AND SWORN to
before me this ____ day of _____, 2014

_____
Notary Public
My commission expires: _____

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Wisconsin Energy Corporation	**)**	
	)	**Docket No. EC14-126-000**
Integrys Energy Group, Inc.	**)**	

I, William H. Hieronymus, Ph.D., being duly sworn, depose and state that the foregoing Affidavit on behalf of the Wisconsin Energy Corporation and Integrys Energy Group, Inc.is true, correct, accurate, and complete to the best of my knowledge, information, and belief.

_____
William H. Hieronymus, Ph.D.

SUBSCRIBED AND SWORN to
before me this ____ day of _____, 2014

_____
Notary Public
My commission expires: _____